Review of "STATUS OFTHE ISO DRAFT STANDARD FOR DETERMINING SOLAR IRRADIANCES (CD12348)"

A. Reviewer

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Summary

This paper, intended for *Advances in Space Research*, is a status update for the ISO draft standard for solar irradiance. It contains no science *per se*. The proposed standard is process-based in that it does not specify the particular levels or models of the solar irradiance, but only how solar irradiance data should be specified. This is quite advantageous since advances in the field expected soon. The provision for four types of solar product is also a positive feature. The authors are to be commended for this type of constructive proposal.

Generally, the paper is competently presented; almost no grammatical errors were found. The major problem with the paper as it now stands is that important technical issues are not properly dealt with while routine programmatic and noncontroversial issues are laid out in excruciating detail. Although the paper is apparently intended to be a status update rather than a presentation and justification of the proposed standard, because of somewhat pedestrian treatment of important technical issues, the paper does not give this reviewer confidence in the quality of the proposed standard. The technical details of an ISO standard should be as flawless as possible.

The first action that the authors could take to give credence to the proposed standard is to provide the text of the draft standard itself to the community. This could be done through the internet. Comments from interested parties should also be solicited. Less information would need to be reported in this status paper if the details of the proposed standard were available elsewhere.

I recommend the paper be published in *ASR* if the issues raised here are addressed. A second review can easily be done, at the discretion of the editor.

Specific Issues or Problems

Irradiance versus Spectral Irradiance

The paper proposes to standardize the presentation of the solar irradiance spectra, among other things. To be precise, the solar irradiance is really synonymous with the "total solar irradiance". Irradiance is the total amount of radiation received by a unit area and has (SI) units of $\mathrm{W{\cdot}m^{-2}}$. (See, for example, "Radiometry and the Detection of Optical Radiation", Robert W. Boyd, John Wiley and Sons, New York, 1983.) A spectral irradiance is the derivative of the irradiance with respect to wavelength and thus can be expressed in units of $\mathrm{W{\cdot}m^{-3}}$. The spectral irradiance integrated over the whole spectrum is therefore the (total) irradiance. The paper should correctly distinguish between *irradiance* and *spectral irradiance*. If the shorthand is properly explained, the term "irradiance" could be used instead of the longer "spectral irradiance" throughout the remainder of the paper.

This is not a trivial matter raised by a over-critical reviewer. In a normal science paper, these issues are often ignored, perhaps for good reason. The difference here is that an international standard is proposed; great confusion can be sowed if the subject is not developed properly and precisely. I would imagine that the authors would like the scientific community to be confident in the quality of the proposed standard.

The Plotted Function

The function displayed in Figure 1 is neither the solar irradiance nor the solar spectral irradiance. According to the accompanying text: "Solar irradiance, as shown in Figure 1, is the Sun's radiation integrated over the full disk of the Sun experessed as a unit of power, W, through a unit of area, $\mathrm{m^{-2}}$ at a specified wavelength, λ, and integrated across a wavelength bandwidth, $\Delta\lambda^{-1}$". The quantity referred to has the units of solar irradiance (W/m^2) but is and integrated solar spectral irradiance and does not have the units given in the figure. Further, the

Rather, it is (probably) the average spectral irradiance of every 1 nm bin. (Or perhaps it is the running 1 nm average of the spectral irradiance.) Again, this should be explained or described.

Figure 1 has other problems. The most obvious is that its presentation is not of high quality. It appears that the plot was generated on a dot matrix printer from an earlier era. Also, it is noted that the boundary for the UV in the figure is not the same as that given in the text. Namely, the boundary between the EUV and the UV is shown to be somewhere near Ly-a (121.6 nm) while in the text, it is 100 nm.

"Irradiance" Units

The paper seems to insist on SI units, but then gives the "solar irradiance" (see below) in units of $\mathrm{W{\cdot}m^{-2}\Delta\lambda^{-1}}$. The problem is that $\Delta\lambda$ is not an SI unit of measurement. If the

standard is going to specify a particular type of unit, then it at least be one that is the same in all instances, i.e. the unit of measurement should not depend on the resolution or sampling. Perhaps the authors intended the unit to be $W/m^2/nm$, but this is not what the paper says. The way that this is presented will likely lead to confusion, if not misreported or misinterpreted data.

One suggestion is to relax the requirement that all solar irradiance products report their values in a single SI-based spectral irradiance unit of measurement. Rather, allow any valid SI unit to be chosen (e.g. $mW/m^2/nm$) but that a factor converting to a designated measurement unit (e.g. $W/m^2/nm$) must be reported also. Whatever the choice of units, an explanation for the choices made would be useful.

Radiance versus Irradiance

On page 2, there is mention of "radiance" without defining the term. The proposed standard does not explicitly deal with solar radiance, although in pages 3 & 4 the paper makes reference to integration "over an identified spatial area". Just where this "identified spatial area" is needs to be clarified. If it is on the Sun, then we are indeed no longer talking about irradiance, but, instead, radiance. In this case, the concept of radiance needs to be more fully developed and openly declared in the standard and in this paper.

Resolution versus Sampling Interval

The presented specification does not clearly distiguish the difference between resolution (aka wavelength bandpass) and wavelength sampling or bin interval. Only the integrated spectral irradiances in each wavelength interval are to be reported. This apparently rules out the reporting of spectral irradiance measurements on intervals smaller than the instrumental resolution. A discussion of the impact of instrumental spectral resolution on the proposed standard would be useful.

Spectral Categories

In the section entitled "Spectral Categories", the categories are, for the most part, well chosen (including the often used alternate definitions). However, this section is far more expansive than it needs to be. Most of the information could be summarized in a table.

On page 5, the "Middle Ultraviolet" is put into the VUV section where it clearly doesn't belong, according to the given definitions. Additionally, researchers often will refer to the "Near UV" as being between 300 and 400 nm.

On page 6, examples of microwave bands are given, but these are given as single wavelengths. As implied by the term *bands*, these have associated wavelength range and not single wavelengths. (For example, see *Reference Data for Radio Engineers*, Fifth Edition, Howard W. Sams & Co., Inc., Indianapolis, Indiana: 1970.) I would recommend that these wavelength identifications be corrected or deleted.

Reporting and Compliance

At a single sentence, the reporting section is far too abbreviated. The minimum report would be different if radiances were presented (see above). Also, there is still the matter of wavelength bins and resolution. The authors should do a better job of telling us how and what is to be reported.

Miscellaneous Suggestions and Problems

On page 3, it is stated: 'The ISO CD21348 draft International Standard, "Process for Determining Solar Irradiances", specifies all representations of solar irradiances ...'. Surely, the authors would accept that there may be ways of specifying solar irradiances which fall outside this standard. Recommend adding "ISO" before "representations" or some other such qualification.

On page 6, 6th line from the bottom should read, " for selecting proxies *are* described".

I suggest adding an additional solar proxy type to the four types of data given in the proposed standard. This would allow different ISO-conforming solar irradiance models to refer to a single previously standardized proxy. This would eliminate redundant proxy descriptions from the set of solar irradiance standard descriptions.